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ABSTRACT

In order to reduce the 35-40% dropout/failure rate in chemistry classes at the Perkinston Campus of Mississippi Gulf Coast Junior College, this study sought predictors which would provide early identification of students in need of special or additional help. Using regression analysis, data accumulated from the achievement records of students over the previous two years were analyzed, including sex, ACT (American College Testing Program) composite scores, IQ scores, previous experience in high school chemistry, and mid-term grades. Sex was found to have almost no value in predicting mid-term grades. Furthermore, although students who had taken a high school chemistry course achieved higher mid-term grades than those who had not, ACT and IQ scores were found to have higher predictive value. ACT scores had the highest predictive value; IQ scores were next in value, but utilization of ACT and IQ scores together had only slightly more predictive value than ACT scores alone. On the basis of these findings, an equation was developed to be used in identifying potential dropouts. (DC)

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Title: PREDICTING MID-TERM GRADES FOR SCIENCE STUDENTS AT PERKINSTON

Institutional Research Report No. 75/76-16

MAY 5, 1976

1. PROBLEM: Mr. Noel Mann, General Science Instructor on the Perkinston Campus became increasingly dissatisfied with the high drop-out rate in his science classes over the past two years. Because of this problem, he sought out and found predictors that would identify to him the probable drop outs early in the semester; thereby identifying students who might need special and extra help from him.

2. DISCUSSION: Using the new terminal tied into the University of Southern Mississippi computer, he conducted research to help him solve his problem. Attached is a copy of his findings as presented to the Central Office. Because of the quality of the research done, and with the permission of Mr. Mann, his study is published as a College-level Institutional Research Report. Mr. Mann is to be commended for his inquisitive attitude, for his research efforts, and for his allowing this report to be published and shared with other persons throughout the College who might benefit from his methodology and findings.

3. It is noted that this is the first published research report of work done on the new terminals. Others are encouraged to follow the example set by Mr. Mann.

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JC 760 407

PREDICTING MID-TERM GRADES

Noel R. Mann
22 April 1976

PREDICTING MID-TERM GRADES

Upon analysis of student progress in my General College Chemistry classes of the past two years, I have been somewhat appalled at the relatively high incidence of dropout/failures. Sciences have been historically notorious for their ability to separate the "chaff" from the "grain". However, even with this axiom as a security blanket, I have been unable to accept a 35-40% mortality rate as the "best that could be expected". Instead, I have attempted to develop some means of detecting potential problem students as early as possible in the school year. It is my firm belief that only through early detection may teachers effectively reduce abhoringly high dropout levels to a percentage that will be much more acceptable to everyone.

In attempting to provide early indications of a potential underachiever or dropout I have called upon statistics, through a regression analysis program, in order to decipher and organize the data accumulated from the achievement records of my students over the previous two years. The types of data compiled included: sex, ACT Composite scores, whether or not the student has taken a high school chemistry course, individual IQ's, and mid-term grades of these students for first

semester General Chemistry. Introduction of this data into the regression program allows the development of a predictive formula.

In addition to the predictive formula, which will be discussed in a later paragraph, there are other tabulations which are of interest. First of all, one item of interest is the mean (average) of the categories utilized in the predictive scheme. The mean IQ, for instance, was approximately 112. The mean ACT Composite was approximately 20.5 as compared to approximately 17 for the Perkinston Campus of Mississippi Gulf Coast Jr. College. Almost 30 percent of the students initially enrolled in General Chemistry were women. Of the students enrolled in General Chemistry slightly more than 83 percent had taken chemistry in high school. Finally, the average first semester mid-term grade was a "C" when based on a 10 point scale.

These means, although not significant in themselves, are somewhat indicative as well as surprising. One usually assumes that a science student is a better student than a non-science major. This idea is enhanced by the average IQ and ACT scores. As compared to our campus average these are significantly higher. Most science instructors chronically complain about the relatively few female students in scientific curriculums. This concept is probably a little out-of-date as evidenced

by the fact that almost one out of three enrolled in General Chemistry over the past two years have been females. Perhaps the most significant mean, as far as destroying my early hypothesis, was the one concerning high school chemi try. My predetermined assumption was that most of the students eventually dropping or failing the course were those who had not previously had high school chemistry. This pre-supposed hypothesis was completely erradicated, however, when observation of the printout clearly indicated that better than four of every five students had participated in high school chemistry.

Analysis of the regression matrix allows a greater insight into the relationship between the predictors and the predictee. First of all, as most "libbers" will agree, there is a slight correlation between higher IQ's and being a female. However, on behalf of the male chauvinist, it must be stated that the correlation is so slight as to be statistically insignificant.

In terms of predicting mid-term grades, the regression matrix indicates that sex has almost no predictive value at all. This seems reasonable, especially in light of the fact mentioned in the previous paragraph, since there appears to be statistical insignificance between males and females in their ability to perform.

A rather enlightening statistical relationship in the regression matrix is found between the mid-term

grades and whether or not the student has had high school chemistry. As mentioned in a previous paragraph, my original hypothesis was simply that the students having the most difficulty with college chemistry were those not having had a high school course in the subject. This hypothesis was pretty well dispelled when the compilation of data indicated that over 83 percent of the students enrolled had, in fact, taken a course in high school chemistry. At best, then, only the remaining 17% could be considered with respect to the original hypothesis. Upon analysis of the regression matrix, however, one finds only a .33 correlation between the mid-term grades and having taken high school chemistry. Because of these two factors the search for some other means of identifying potential problem students continued. This led to the utilization of the various models in the regression analysis program.

The objective of utilizing different models is simply to determine what items serve as the best and strongest predictors. In essence, the different models amount to about the same thing as removing supports from a bridge until the bridge noticeably weakens. The same thing happens when the various models are programmed into the computer. One selectively introduces the predictor variables in order to observe their effect on the criterion variable.

Model 1, for instance, utilizes all four predictors in attempting to develop a mathematical means of estimating mid-term grades. In this model, apparently the ACT scores have the greatest single predictive value, as has been stated previously concerning analysis of the regression matrix. Second in order of predictive value is IQ, once again consistent with analysis of the regression matrix. It should be noted, however, that there is only a slight increase in the correlation of mid-term grades and the use of ACT as well as IQ scores as compared to ACT alone. Whether or not the student has taken a course in high school chemistry is the third best predictor but only has a marginal effect on the predictive efficiency of the program. Finally, as one would have expected, sex has practically no additional predictive value for the system.

Model 2 consists simply of utilizing high school chemistry as the sole predictor for the criterion of mid-term grades. This model indicated that the average mid-term grade for a student enrolled in general chemistry was approximately 74 for an individual having had high school chemistry while only 57 for an individual not having had chemistry in high school. This information appears to revive, somewhat, the original hypothesis. As pointed out earlier, however, other factors have more influence on predictability (i.e., ACT, IQ) than having taken

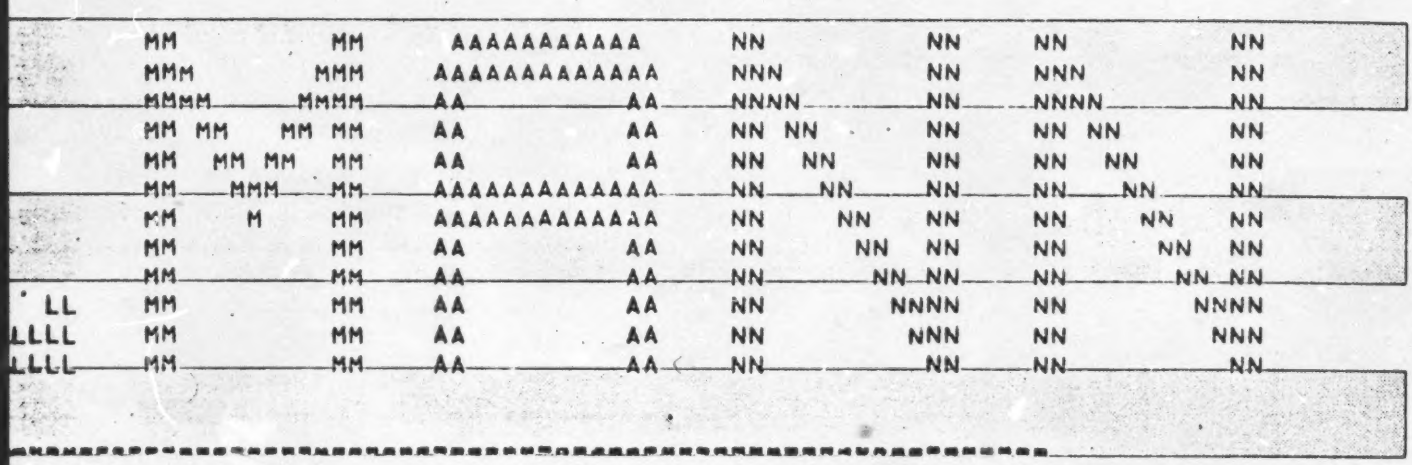
the course in high school. It is interesting to note, however, that the difference between the two students is the difference between a middle "C" and a high "F"!

The last point of interest in the program is to develop the equation by which one may determine the approximate mid-term grades of students enrolled in Chemistry. Utilization of the regression constant and the "B" weights found in Model 1 allows one to assimilate the following equation: $X_4' = -10.7063 + .2763X_1 + 2.2612X_2 + 2.0492X_3 + 5.2549X_5$ where X_4' is the predicted mid-term score, X_1 is the IQ score, X_2 is the ACT score, X_3 is the sex variable, and X_5 is the high school chemistry variable.

Ideally, this equation will allow early identification of a potential problem student at the earliest possible stage. Previously, this identification did not occur until four or five weeks after the semester had begun and the first test administered and graded. By this time, however, a problem student may well be irretrievably lost. The purpose of developing the equation is an attempt to provide early assistance to these students in order to reduce the high incidence of student failure in a technical course such as General Chemistry. Follow up studies will be initiated on each year's entering freshmen in order to attempt validation of the equation. Until such time as this validation process has been

completed, premature utilization could possibly prove to have a further negative influence rather than the anticipated positive influence. The future potential of early identification of problem students appears, however, to drastically outweigh any minor negative problems associated with the predictive system.

THERN MISSISSIPPI SIGMA9/CP-V COMPUTER SYSTEM


MM MM AAAAAAAAAA NN NN NN NN
MMM MMM AAAAAAAAAAAA NNN NN NNN NN
MMMM MMMM AA AA NNNN NN NNNN NN
MM MM MM MM AA AA NN NN NN NN NN NN
MM MM MM MM AA AA NN NN NN NN NN NN
MM MMM MM AAAAAAAAAAAA NN NN NN NN NN NN
MM M MM AAAAAAAAAAAA NN NN NN NN NN NN
MM MM AA AA NN NN NN NN NN NN
MM MM AA AA NN NN NN NN NN NN
LL MM MM AA AA NN NNNN NN NNNN
LLLL MM MM AA AA NN NNN NN NNN
LLLL MM MM AA AA NN NN NN NN

THERN MISSISSIPPI SIGMA9/CP-V COMPUTER SYSTEM

COLLEGE CHEMISTRY ACHIEVEMENT FACTORS

PARAMETERS

COL 1-5 =	5
COL 6-10 =	71
COL 11-15 =	4
COL 16-20 =	4
COL 21-25 =	1
COL 26-30 =	1

DATA FORMAT

(A2,F3.0,F2.0,F1.0,F3.0,F1.0)

INTERCORRELATION ANALYSIS.

	IQ 1	ACT 2	SEX 3	MID-TERM GRADES 4	H.S CHEM 5
MEANS	111.9014	20.5352	.2958	71.4225	.8310
SIGMAS	10.7785	4.1617	.4564	20.2308	.3748

R MAT	1	2	3	4	5
1	1.0000	.7658	-.0771	.5342	.3446
2	.7655	1.0000	-.0537	.6133	.3921
3	-.0771	-.0537	1.0000	.0063	-.0371
4	.5342	.6133	.0063	1.0000	.3289
5	.3446	.3921	-.0371	.3289	1.0000

```
MODEL  1      CRITERION =  4

PREDICTORS =  1= 3  5= 5
P =  2   RSQ =  .3761
P =  1   RSQ =  .3863
P =  5   RSQ =  .3941
P =  3   RSQ =  .3962

R =  .6295      RSQ =  .3962          4 ITERATIONS.

   V        BETA          B
   1        .1472        .2763
   2        .4651       2.2612
   3        .0462       2.0492
   5        .0973       5.2549
REG. CONST. =  -10.9063
01      PY 1     93.5851
02      PY 1     79.2395
03      PY 1     88.2337
04      PY 1     69.9185
05      PY 1     73.9387
06      PY 1     79.9071
07      PY 1     83.4855
08      PY 1     69.2158
09      PY 1     81.8919
11      PY 1     81.5007
12      PY 1     82.4446
13      PY 1     50.2721
14      PY 1     82.3802
15      PY 1     59.9659
16      PY 1     72.5570
17      PY 1     80.0685
18      PY 1     63.9035
19      PY 1     71.1387
20      PY 1     43.5850
21      PY 1     64.3413
22      PY 1     43.6355
23      PY 1     54.1263
24      PY 1     58.7136
25      PY 1     86.6861
26      PY 1     88.7864
27      PY 1     79.5159
28      PY 1     83.2736
29      PY 1     71.4151
30      PY 1     88.2842
31      PY 1     63.1855
```

32	PY 1	86.0230
33	PY 1	57.9490
34	PY 1	82.3973
35	PY 1	58.5337
36	PY 1	87.1284
37	PY 1	69.3658
38	PY 1	83.4995
39	PY 1	80.0685
40	PY 1	76.9784
41	PY 1	82.7209
42	PY 1	70.1204
43	PY 1	61.0208
44	PY 1	52.7446
45	PY 1	58.7136
46	PY 1	84.2672
47	PY 1	89.6659
48	PY 1	50.8248
49	PY 1	60.4865
50	PY 1	55.4620
51	PY 1	58.9900
52	PY 1	65.1703
53	PY 1	72.2302
54	PY 1	73.6118
55	PY 1	50.5944
56	PY 1	60.0953
57	PY 1	89.9422
58	PY 1	68.3249
59	PY 1	82.3297
60	PY 1	74.5557
61	PY 1	86.0230
62	PY 1	71.0743
63	PY 1	72.2302
64	PY 1	59.0359
65	PY 1	77.5310
66	PY 1	70.8624
67	PY 1	73.8377
68	PY 1	69.8535
69	PY 1	40.3195
70	PY 1	69.7571
71	PY 1	80.9480

MODEL 2 CRITERION = 4
PREDICTORS = 5= 5
P = 5 RSQ = .1082

R = .3289 RSQ = .1082 1 ITERATIONS.

V	BETA	B
5	.3289	17.7571
REG. CONST. =		56.6666
01	PY 1	74.4237
02	PY 1	74.4237
03	PY 1	74.4237
04	PY 1	74.4237
05	PY 1	74.4237
06	PY 1	74.4237
07	PY 1	74.4237
08	PY 1	74.4237
09	PY 1	74.4237
10	PY 1	74.4237
11	PY 1	74.4237
12	PY 1	74.4237
13	PY 1	74.4237
14	PY 1	74.4237
15	PY 1	56.6666
16	PY 1	74.4237
17	PY 1	74.4237
18	PY 1	74.4237
19	PY 1	74.4237
20	PY 1	56.6666 NOT HAVE H.S. CHEM
21	PY 1	74.4237
22	PY 1	56.6666
23	PY 1	56.6666
24	PY 1	74.4237
25	PY 1	56.6666
26	PY 1	74.4237
27	PY 1	74.4237
28	PY 1	74.4237
29	PY 1	74.4237
30	PY 1	74.4237
31	PY 1	74.4237
32	PY 1	74.4237
33	PY 1	74.4237
34	PY 1	74.4237
35	PY 1	56.6666
36	PY 1	74.4237
37	PY 1	74.4237
38	PY 1	74.4237
39	PY 1	74.4237
40	PY 1	74.4237
41	PY 1	74.4237
42	PY 1	74.4237
43	PY 1	56.6666
44	PY 1	56.6666
45	PY 1	74.4237
46	PY 1	74.4237

47	PY 1	74.4237
48	PY 1	74.4237
49	PY 1	74.4237
50	PY 1	74.4237
51	PY 1	74.4237
52	PY 1	74.4237
53	PY 1	74.4237
54	PY 1	74.4237
55	PY 1	56.6666
56	PY 1	74.4237
57	PY 1	74.4237

41	PY 1	75.5323
42	PY 1	45.4496
43	PY 1	72.5241
44	PY 1	51.4662
45	PY 1	61.4937
46	PY 1	82.5516
47	PY 1	83.5544
48	PY 1	57.4827
49	PY 1	60.4910
50	PY 1	50.4634
51	PY 1	62.4965
52	PY 1	68.5130
53	PY 1	69.5158
54	PY 1	74.5296
55	PY 1	67.5103
56	PY 1	66.5075
57	PY 1	84.5571
58	PY 1	72.5241
59	PY 1	81.5489
60	PY 1	70.5186
61	PY 1	78.5406
62	PY 1	73.5268
63	PY 1	69.5158
64	PY 1	73.5268
65	PY 1	80.5461
66	PY 1	73.5268
67	PY 1	83.5544
68	PY 1	72.5241
69	PY 1	38.4304
70	PY 1	64.5158
71	PY 1	76.5351

MODEL 4 CRITERION = 4

PREDICTORS = 2= 2
P = 2 RSQ = .3761

R = .6133 RSQ = .3761 1 ITERATIONS.

V	BETA	B
2	.6133	2.9812
REG. CONST. =		10.2022

01	PY	1	93.6769
02	PY	1	78.7707
03	PY	1	87.7144
04	PY	1	66.8457
05	PY	1	75.7894
06	PY	1	78.7707
07	PY	1	84.7332
08	PY	1	54.9208
09	PY	1	81.7519
10	PY	1	75.7894
11	PY	1	81.7519
12	PY	1	81.7519
13	PY	1	48.9583
14	PY	1	84.7332
15	PY	1	66.8457
16	PY	1	75.7894
17	PY	1	78.7707
18	PY	1	63.8645
19	PY	1	66.8457
20	PY	1	45.9771
21	PY	1	63.8645
23	PY	1	57.9020
24	PY	1	57.9020
25	PY	1	87.7144
26	PY	1	87.7144
27	PY	1	78.7707
28	PY	1	81.7519
29	PY	1	66.8457
30	PY	1	90.6956
31	PY	1	60.8833
32	PY	1	87.7144
33	PY	1	54.9208
34	PY	1	81.7519
35	PY	1	63.8645
36	PY	1	87.7144
37	PY	1	66.8457
38	PY	1	78.7707
39	PY	1	78.7707
40	PY	1	75.7894
41	PY	1	81.7519
42	PY	1	78.7707
43	PY	1	63.8645

```
44      PY 1    57.9020
45      PY 1    57.9020
46      PY 1    84.7332
47      PY 1    90.6956
48      PY 1    48.9583
49      PY 1    57.9020
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51      PY 1    57.9020
52      PY 1    63.8645
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56      PY 1    57.9020
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59      PY 1    81.7519
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62      PY 1    69.8270
63      PY 1    72.8082
64      PY 1    60.8833
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66      PY 1    66.8457
67      PY 1    69.8270
68      PY 1    72.8082
69      PY 1    48.9583
70      PY 1    66.8457
71      PY 1    81.7519
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LOS ANGELES

AUG 27 1976

CLEARINGHOUSE FOR
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```
F-TEST  1     SIGNIFICANCE OF PREDICTIVE SYSTEM
RSQ FULL =      .3962      MODEL  1
RSQ REDUCED =   .0000      MODEL  0
DIFFERENCE =    .3962
DFN =  4.     DFD =   66.     F-RATIO =  10.828   P =  .0000

F-TEST  2     EFFECT OF REMOVIG IQ,ACT,SEX,(HS CHEM)
RSQ FULL =      .3962      MODEL  1
RSQ REDUCED =   .1082      MODEL  2
DIFFERENCE =    .2880
DFN =  3.     DFD =   66.     F-RATIO =  10.495   P =  .0001

RSQ FULL =      .3962      MODEL  1
RSQ REDUCED =   .2854      MODEL  3
DIFFERENCE =    .1108
DFN =  3.     DFD =   66.     F-RATIO =   4.038   P =  .0107

F-TEST  4     EFFECT OF REMOVING IQ,SEX,HS CHEM (ACTE
RSQ FULL =      .3962      MODEL  1
RSQ REDUCED =   .3761      MODEL  4
DIFFERENCE =    .0201
DFN =  3.     DFD =   66.     F-RATIO =    .733   P =  .5388
*STOP* 0
```